

# **CIE Biology GCSE**

## **19: Organisms and their environment**

### **Notes**

## Food chains

### Key words:

- **Producer** - an organism which converts light energy to chemical energy in order to produce its own nutrients.
- **Consumer** - an organism which gets energy from feeding on other animals or plants.
- **Food chain** - a diagram which shows the order of energy transfer through feeding in an ecosystem.
- **Food web** - a diagram showing how different food chains interact with each other.
- **Trophic level** - the trophic level of an organism refers to its position in the food chain, food web, pyramid of numbers or pyramid of biomass.
- **Pyramid of numbers** - shows the number of organisms in each trophic level of a food chain.
- **Pyramid of biomass** - shows the total mass of organisms in each trophic level of a food chain.
- **Biomass** - the total mass of living material.
- **Herbivore** - organisms which feed on plants.
- **Carnivore** - organisms which feed on animals.
- **Decomposer** - organisms which break down decaying organic material.

Energy is introduced into biological systems as **light energy** which is absorbed by plants, where the **Sun** is the principal source of energy. This energy is then transferred to **chemical energy** and can pass to other organisms through **feeding**. When these animals die, they are broken down by **decomposers** which return their nutrients to the soil.

A **food chain** shows the order of energy transfer between organisms. Food chains start with **producers**, which are plants which convert light energy from the Sun to chemical energy. Organisms which feed on plants, or other animals, are known as **consumers**. Plants are eaten by **herbivores**, which **gain nutrients** from the plants that are used for growth. This consumer is then eaten by another animal which gains the nutrients from the first. Each of these organisms has its own **trophic level**. Consumers are classed as **primary, secondary, tertiary or quaternary**, depending on their position in the food chain.

**Energy is passed between trophic levels**, although this process is **highly inefficient** due to a variety of reasons:

- **Not all animal and plant material can be digested** to gain energy from, e.g. fur and bones.
- **Energy is lost** through excretion and decay.
- **Energy is used in other processes**, e.g. movement and keeping warm.

This means that **organisms later on in the food chain gain less energy from their food** than organisms earlier on, as energy is lost at each level. Consequently, organisms later in the food chain must eat a larger amount to gain enough energy for survival. For this reason, there are usually **not more than five trophic levels** as too much energy would be lost to sustain another. This is also why it is **more efficient for humans to eat plants** rather than animals, as there are more stages in the food chain if animals are present.

A **pyramid of numbers** can be used to show the number of organisms in each trophic level. This is similar to a **pyramid of biomass**, which measures the total biomass of all the organisms at each level. A pyramid of biomass tends to have a true pyramid shape as **biomass is lost in each level** which corresponds to the energy lost. A pyramid of biomass therefore is more useful as it gives an indication of the amount of energy being passed on at each stage of the food chain.

#### **Human impact on food chains:**

Humans alter food webs through **over-harvesting food** species and **introducing foreign species** to habitats. Over-harvesting will damage food chains as other organisms which consume these organisms will **not have enough food to survive**, meaning that many of them will die. Introducing foreign species may have the same effect as there is now **competition for resources**, which could damage existing species by interfering with the food chain.

An example of this is **cane toads**, which were introduced to Australia to eat pests. Due to their toxic skin, they have **destroyed many native species** and **damaged habitats**, especially water habitats, where the **biodiversity has been reduced**. This has had a negative effect on the bird population which preyed on animals living in these areas. This shows that when one trophic level is damaged, all that follow are also impacted as the amount of food for them decreases.

# Nutrient cycles

## The carbon cycle:

**Carbon** is an essential **element** which makes up the majority of molecules in living organisms. The carbon cycle is used to show how carbon atoms move between the **atmosphere and living organisms**:

1. Carbon is present in the **atmosphere** in the form of **carbon dioxide**, which makes up about 0.04% of the air.
2. Carbon dioxide is taken in by plants during **photosynthesis**. Here, the carbon is transferred from carbon dioxide to other molecules such as **proteins and carbohydrates**.
3. These molecules are **passed through the food chain** when **feeding** occurs, hence carbon is also passed between the trophic levels.
4. Carbon is **returned to the atmosphere during respiration**, which releases carbon dioxide, and during **decomposition**.

Carbon can be trapped in dead organisms when decomposition does not occur. These organisms become **fossilised** over thousands of years to form **fossil fuel**. When this fossil fuel is **burned**, large amounts of carbon dioxide is released back into the atmosphere. This, along with the effect of **deforestation**, leads to the amount of carbon dioxide in the atmosphere increasing, which causes **global warming**.

## The water cycle:

1. Water **evaporates** from bodies of water such as lakes and rivers to form water vapour (gas). It also is released from plants during **transpiration**.
2. This water vapour rises upwards and begins to **cool**. When it cools, **condensation** occurs, turning the vapour back into liquid water which forms clouds.
3. When the cloud becomes too heavy, water falls from the cloud as **precipitation** (rain, snow, hail etc.).
4. This water is then taken up by plants and animals, or returns to a body of water, so that the cycle can continue.

## The nitrogen cycle:

Nitrogen is another element which is key to biological lifeforms. Nitrogen is used to make **amino acids, DNA and ATP**, which is a molecule that releases energy. **Microorganisms** are key to the nitrogen cycle as they help to convert nitrogen to different forms so that it can be used.

1. **Nitrogen gas** is present in the air. This nitrogen is **fixed** (converted to useable nitrate ions) by **nitrogen-fixing bacteria** which live on the root nodules of some plants, or by **lightning**.
2. Plants **absorb** these nitrate ions and use them to make other molecules, such as amino acids and proteins.
3. These molecules are **passed through the food chain** via feeding.
4. Nitrogen is returned to the soil in the form of **ammonia** when decomposition occurs, or in the form of **urea**, which is excreted from organisms after **deamination** occurs. If this decomposition occurs in **anaerobic** conditions (without oxygen) then **denitrifying bacteria** can break down nitrates and return nitrogen gas to the atmosphere.

## Population size

### Key words:

- **Population** - A group of organisms of the same species living together in one habitat.
- **Community** - Populations of many different species living together in one ecosystem make up a community.
- **Ecosystem** - A system in a specific area which contains a variety of living organisms which work together within the environment.

### Factors affecting rate of population growth:

- **Food supply** - if there is a large amount of food, organisms can breed more successfully. If there is a food shortage, there is a higher death rate which results in a slow or negative population growth.
- **Predation** - organisms which have lots of predators will have a slower rate of population growth as more will be killed by predators.
- **Disease** - disease can reduce the population by killing organisms. In densely populated areas, disease can spread quickly, thus a large proportion of the population may be wiped out.

### Human population growth:

Over the last 250 years, the human population has risen from just over **1 billion to 7.6 billion**. There are many **social and economic implications** of this. Due to the massive demand for resources and space, **deforestation** occurs, and a high amount of **fossil fuels** are burnt. This leads to **global warming** and also **damages habitats**. Rapid population growth also puts a **strain on services** such as healthcare and education, meaning that many people cannot access these services, which **lowers quality of life**.